SUPPLEMENT.

The Mining Journal,

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FORMING A COMPLETE RECORD OF THE PROCEEDINGS OF ALL PUBLIC COMPANIES.

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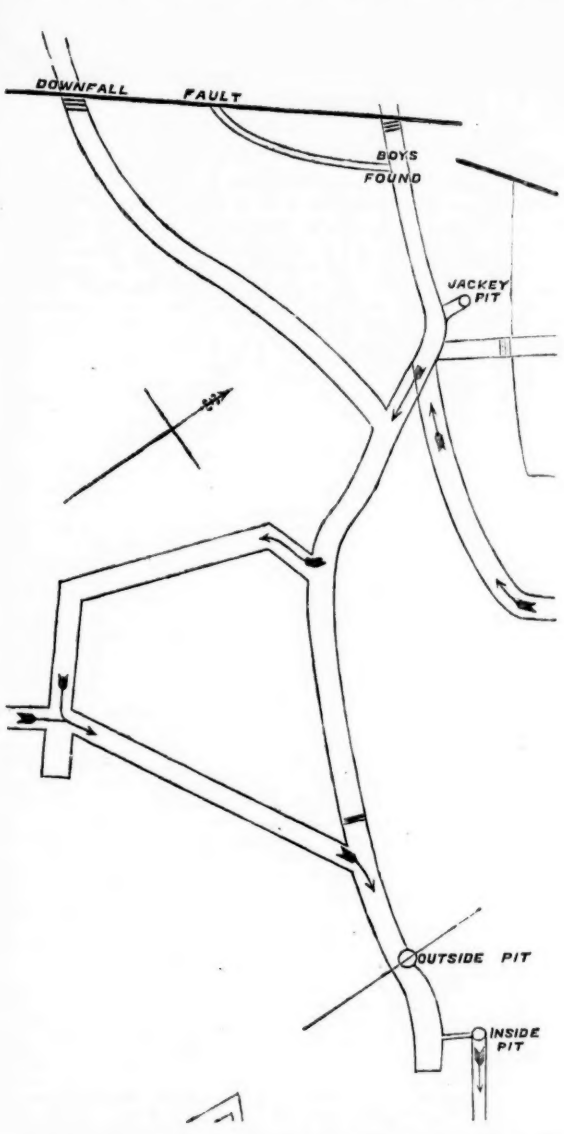
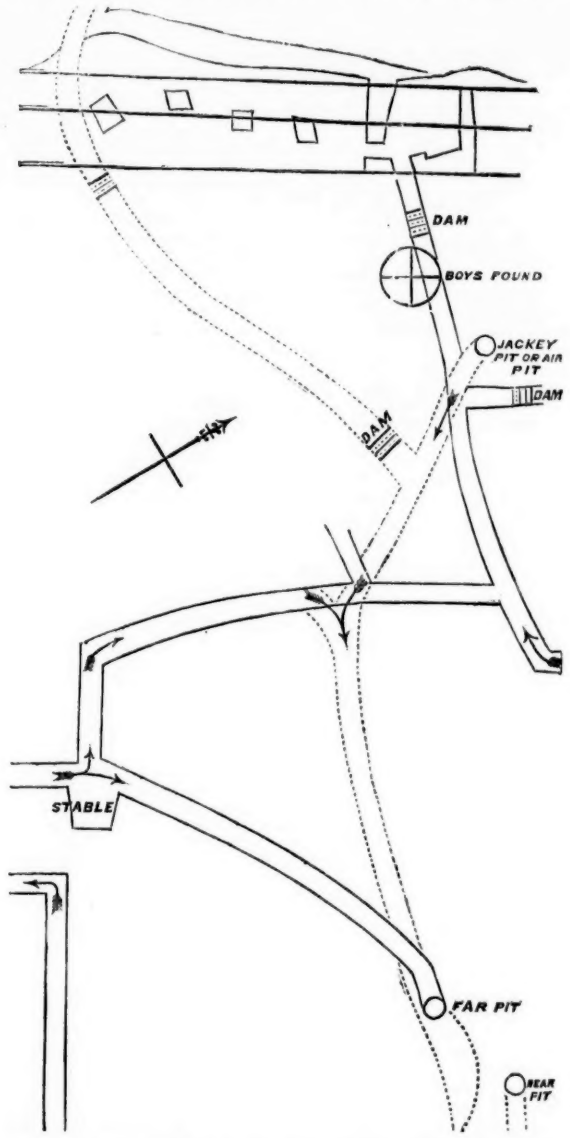
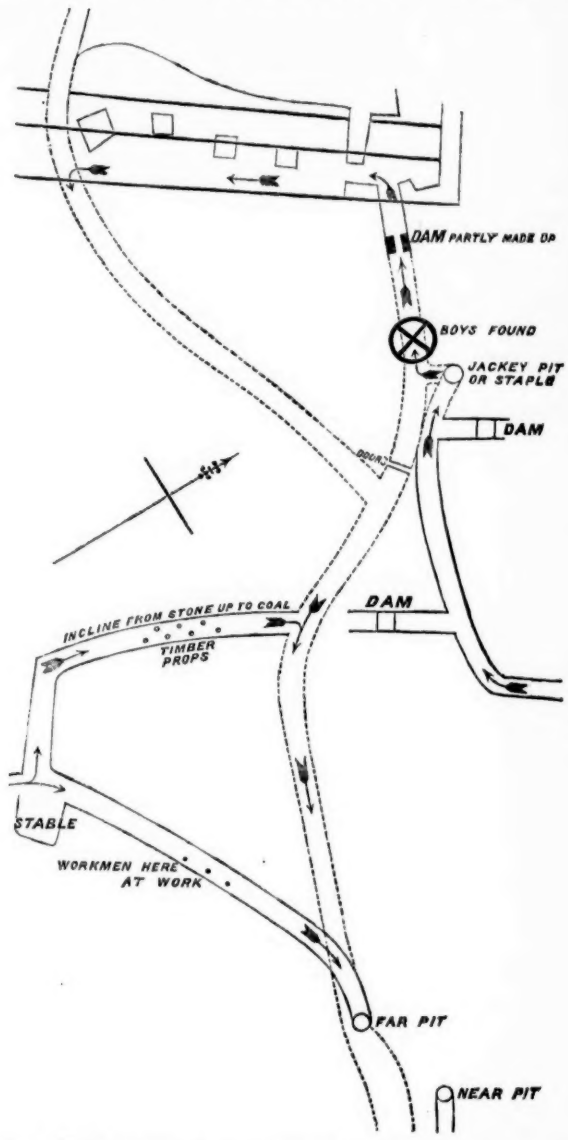
COAL MINE INSPECTORS' PROSECUTIONS—NEGLECT OF GENERAL RULES AT BROMFORD COLLIERY.







GOVERNMENT INSPECTION OF COAL MINES—THE INSPECTORS' REPORTS—No. II.

Difficulty of Fixing Responsibility.—Although from the lengthened period which has elapsed between the date of the Inspectors' reports and their issue to the public many of the accidents to which they refer have been almost entirely forgotten, the case—Regina *v.* Cope—was one of such an extraordinary nature that the official statement of Mr. Baker has been looked forward to with especial interest. It was not unnaturally supposed that the discovery of the owner of a colliery, or of the person having "on behalf of the owner the care and direction thereof," would offer no difficulty, yet the case of Regina *v.* Cope has proved that precisely the reverse is the fact. It is true that in spite of the confusion which it was attempted to import into the case the agent was convicted and heavily fined, yet it cannot but be regretted that a colliery owner, who might reasonably be supposed to be as much interested in the safe and proper working of the colliery as the workmen, should refrain from rendering every assistance to facilitate the administration of justice, and to secure the punishment of those whose neglect has led to the sacrifice of life. The case of Regina *v.* Cope arose out of a fatal accident (alluded to in the Inspector's report for 1866), which occurred at the Bromford Colliery, near West Bromwich, belonging to Mr. W. H. Dawes, a magistrate of Staffordshire and Worcestershire. At the inquest on two of the bodies, all the witnesses—John Turner, the doggy, and the father of the younger boy, Richard Moore, the butty of the mines, Benjamin Callear, the underground bailiff, and Mr. Cope, the agent—agreed in stating that this disused gate-road was unsafe to enter, and was not fenced off in any way whatever so as to prevent persons from entering it. The two last witnesses said it ought to have been fenced off. It was clear that the three deceased persons had no business in the place where they met with their deaths; whether they entered by accident or to avoid working longer no one can tell, and is quite immaterial to the issue raised. The jury returned a verdict of "Accidental Death;" but the Coroner told Mr. Cope, the agent, his deputy, Ben. Callear, and the butty, Rd. Moore, that they "had had a narrow escape from a verdict of manslaughter." Under these circumstances the Secretary of State ordered an action to be brought against the agent for a violation of the 2d General Rule of the Coal Mines Inspection Act, which provides that these rules "shall be observed in every colliery or coal mine or ironstone mine by the owner and agent thereof." This rule is as follows:—"All entrances to any place not in actual course of working and extension, and suspected to contain dangerous gas of any kind, shall be properly fenced off, so as to prevent access thereto." At the inquest Mr. Cope had described himself as a "mine agent" acting for Mr. W. H. Dawes, the proprietor, and stated that Callear superintended the underground workings, but that he (Mr. Cope) instructed him. He also said that he was down the pit 10 days before the accident. Both he and Callear, and the butty, acknowledged that the gate-road where the deceased persons were found was a dangerous place, likely to contain gas, and ought to have been fenced off. Mr. Cope, in his correspodnence with Mr. Baker, described himself as the "mine agent," and spoke of the colliery as under his "supervision," always meeting Mr. Baker in that capacity. After receiving his instructions from the Home Secretary, Mr. Baker several times saw Mr. Dawes, with a view to distinctly learn who was his agent at the Bromford Colliery, but he evaded the question, saying that he regarded the butty colliers as the persons really responsible. Application was, therefore, made in writing, and Mr. W. H. Dawes, the owner of the pit, in reply to the Government Inspector's enquiry, returned James Cope as the principal agent; "B. Caleor" as sub-agent; and Richards and Kennedy, and Jenkins and Moore, as butty colliers. Proceedings were at once taken against Mr. Cope. At the trial Mr. Dawes described Cope as "consulting mine agent;" but said "his duty is to superintend the working of the mines, and to give advice when there is any question of difficulty." He also said that there was no one over defendant, adding, "Mr. Cope, after seeing me, gives directions to the agent under him, the sub-agent Callear; and Callear instructs the butties, who do the work." Mr. Spooner asked; "Is there anyone answerable to you for the general ventilation of the pit?" to which Mr. Dawes replied, "I look to the consulting agent, Mr. Cope." Upon the Act of Parliament being put into his hands (the Stipendiary requesting him to interpret the clause) he stated that he considered "Callear to be the person having on behalf of the owner the care and direction of the mine;" but upon Mr. Dawes evading the question—"Did you appoint Callear?" Callear was called and examined. He described himself as underground bailiff, and admitted that he had a master besides Mr. Dawes—Mr. Cope; and that Cope sometimes gave orders to him and sometimes to the butties; he obeyed his directions, and was "the person who has the care of the pit on behalf of the owner"—"under Mr. Cope." It was shown that Cope frequently descended the pit. The magistrate at once decided against the defendant, that this was a place suspected to contain dangerous gas, and that it was not properly fenced. He, however reserved his judgment on the other point—whether the defendant was the agent responsible with the owner for the observance of the general rules. He afterwards announced his decision on this point in the following terms:—"After a careful consideration of the evidence, I have come to the conclusion that the defendant was the agent of the colliery, he being the person having (in the words of the statute), 'on behalf of the owner, the care or direction thereof.' I think Callear was only the ground bailiff of the pit, with the duties and responsibilities attached thereto; and that, having been engaged and acting as ground bailiff, he would have had a complete answer if he had been charged, as agent, with an offence against the Act, by showing what his employment was, and also that he had (as he had stated in his evidence) received directions from the defendant respecting the fencing of dangerous places. I, therefore, find that the defendant was the agent of the colliery within the meaning of the 23d and 24 Vict. cap. 151, and that he neglected to fence off, so as to prevent access thereto, the entrance to a place in the said colliery not in actual course of working and extension, and suspected to contain dangerous gas, and that he knew the place was suspected. Considering, therefore, the absolute necessity that the rules prescribed by the Act of Parliament for the safety of the workmen in the mines should be rigidly observed, I think it my duty to impose on the defendant the penalty of 20*l.* and costs."

But the most remarkable feature in connection with the case appears to be the great discrepancy existing between the several plans issued from time to time on behalf of the defendant, the differences extending not only to the erection of doors and a dam, but also to the complete reversal of an air-course, having an important bearing upon the case. The above diagrams will render this more apparent—each purports to show the workings between the Fault and the Near Pit in one direction, and between the Jackey Pit and the stables in the other. The plan No. 1 was produced by Mr. Cope himself at the inquest, and he stated in his evidence that it was a correct plan of the workings. Plan No. 2 was produced by the defence to represent the workings at the hearing of Mr. Cope's case, and the mine surveyor of the colliery was called to verify it. Plan No. 3, which materially differs from the others, was published in a pamphlet since the case was heard by the representatives of the Incorporated Association of Mine Agents of South Staffordshire—a society instituted in consequence of the panic which the result of the case "Regina *v.* Cope," created amongst mine agents who had previously been accustomed to shift the responsibility properly belonging to themselves upon the deputies and butty colliers employed under them. It will be observed that according to No. 1 plan the air is compelled to go from the Jackey Pit to the stables, and thence to the Far Pit; whilst in No. 2 plan a dam is introduced in the road to the southward of that in which the boys were found, but the air is now shown running direct from the Jackey Pit to the Far Pit (in the white ironstone?), without going near the stables—the air from the Far Pit roads coming in, indeed, in the reverse direction, about midway on the direct road, between the pits mentioned. In No. 3 plan the dam (referred to in No. 2) is removed, and a new pair of doors are inserted, the effect of which is entirely to turn the air and make it pass from the Jackey Pit through the road where the boys were found, and thence along the fault and through the southern road (stopped off by the dam in plan No. 2) to the Far Pit. The plans from which the above diagrams are engraved were copied from the originals (authenticated by the name of Mr. Thomas Brettell, of Dudley, No. 1 being dated 1866, and the other two 1867) by Mr. H. H. Beckett, of Wolverhampton, and are inserted in the Government report. The decision is of considerable importance, as it brings home the responsibility for the management of mines to those occupying the highest position under the owner; and which, judging from the nature of the defence, and the comment the case

has excited, was not previously fully recognised, but to which a similar class of persons in other mining districts cheerfully submit. The spirit of the Coal Mines Inspection Act, and all experience of its working, concur in supporting the principle that the responsibility for the safe conduct of mining operations should be placed as high as possible, as all employed in subordinate positions are subject to the control of those above them.

Accidents in Winding—Objections to Safety-Cages.—There are one or two descriptions of apparatus for the purpose of detaching cages from the winding ropes, in the event of overwinding, which, when used in connection with extra keps or catches, to arrest the cage immediately it becomes detached, are, Mr. Atkinson thinks, calculated to prevent accidents and to save life; and he could wish to see one or other of them generally adopted. But he entertains grave doubts as to whether even the best of the very numerous apparatus hitherto brought under public notice for arresting the progress of a cage in falling down a shaft after the breakage of the winding rope, is not as likely and as liable to cause accidents and loss of life by partially arresting the descent of the cage, and then allowing it to fall away, and, by the jerk, to break the rope through coming into operation when not required, as it is to prevent such accidents and to save life. The use of an apparatus of the above description would probably, in some cases, lead to winding ropes being more frequently used until they break than at present, and, if so, anything short of the most perfect certainty of action on the part of the apparatus would necessarily involve an increased danger from their use in this particular respect. He has witnessed some experiments with what, by some persons, was deemed to be the best of this class of apparatus, and he thinks it failed to arrest the descent of the cage more frequently than it succeeded in doing so.

Mr. Brough, with regard to special contrivances for saving life in case of the rope breaking whilst the cage is in motion in the shaft, by no means sees any objection to the use of such apparatus, but he repeats that he does himself place great reliance on steam-power capable of dealing with drums of great diameter, carrying ropes of maximum strength, and that the ropes themselves be made of the best wire that can be purchased. Everything connected with lowering the people away to their work and bringing them up again should be of the strongest and of the most complete kind, for it is often through defective means that shaft accidents take place.

Prevention of Shaft Accidents.—Some of these accidents are, in Mr. Evans' opinion, preventable; falling out of the cages whilst descending or ascending is often the result of carelessness in not taking firm hold. If all pits were fitted with properly made self-acting fence-gates there would be no falling from surface. Great care should be taken in having all loose stones and coal removed from off the stages and around the top, as they are liable to fall, perhaps while persons are in the shafts. A man fell from off a scaffold. He found, on examination, the cross-bars under the scaffold had not been put sufficiently far into the sides to carry the weight.

The means of communicating distinct and definite signals are, Mr. Brough considers, strictly necessary, as also a proper "load indicator," and a simply contrived, but powerful, break. In addition to all these, the cage should be so constructed that when men are travelling in it they should be unable to fall out, and that they be barricaded from danger at all the sides, as well as overhead. The top of the pit should never be without protection, and the best arrangement for that purpose, no doubt, is that of "lifting guards or wickets."

Accidents on Inclined Planes.—Men of more mature age should, in Mr. Wynne's opinion, be exclusively employed in the working of inclined planes, as it is dangerous work; and in cases where one only is employed two would make it comparatively safe, for it often happens that the person at the top of the jig turns off the load, and then runs to the break, which gives the load a sudden jerk, and often breaks the chain or throws the load off the rails, in either case endangering the life of the boy at the bottom, or of the man who puts the load on the rails again. No person should be allowed to "catch" tubs at the bottom of inclines, or to go near them whilst in motion, nor should one person ever attempt to put a load on the rails again without another being at the break. The man having charge of the horse roads should keep a watchful eye on the drivers, and not allow them to unhook the horse whilst the train is in motion, for two very sad cases have happened during the year of boys trying to unhook, and being run over.

Accidents through Carelessness.—Referring to the shaft accidents, Mr. Wynne remarks that the loss of life under this head is discreditable. To find that 20 persons have lost their lives in this district by accidents in shafts, where only 6,000,000 tons of coal is raised, whilst only two were killed in shafts in Durham, where 15,500,000 tons were raised, is enough to make our managers thoroughly ashamed of the position which, from neglect and want of proper and ordinary care, the district has been brought to occupy in mining statistics; and he hopes it will rouse them to a sense of the rottenness of a system that cannot bear a comparison with other parts of England without odium attaching to those who continue this slaughtering system. Three men were killed by ropes and chains breaking, which may happen with the exercise of the utmost care and diligence. In one case now under observation the main hook broke without showing the slightest flaw, and in another case a chain broke which had recently been placed on the jig and tested, and in which no flaw could be found. But what can be said to mitigate the censure that five men have actually fallen from the surface down open shafts, when guides and lifting fences would have saved all those lives; again, three have fallen from mouthings part way down, when a bar across, that the tub would go under, would have saved them. In a case at the Old Park, Wellington, four men were killed whilst descending, and it was clearly shown that both the engineman and the field engineer were quite aware that the journal of the fly-wheel shaft had worn the brass bearing nearly through, yet took no means to supply a new one, and on the morning of May 15 the brass broke, releasing the main from the drum shaft, which caused a run, and killed four of the men who were descending. In this case the coroner's jury returned a verdict of "Manslaughter" against the field engineer, but at the trial at Shrewsbury he too was acquitted. This, however, did not create much surprise, for the more guilty party was the engineman, who continued to work the engine when he knew it was highly dangerous to do so; and there appears to be in mining districts a very great difficulty in obtaining a conviction in cases of negligence in colliery operations, which Mr. Wynne attributes to the fact that the jurymen will not believe a man can be negligent when his own life is at stake.

Importance of Steam Power and Tail-Ropes.—Referring to crushes by tubs or trams, Mr. Brough, reports with regard to his district that with the system of narrow levels, and the equally narrow cross-headings, half course or so to rise, with weakly young drivers to "back" or "shaft" the sets (for they have no limbers), there is but little hope of cessation of dreadful accidents. Another of the bad features in it is taking the door boys from their stations and making them go with the hauliers; it is painful to reflect on the number of deaths of the merest of children from time to time have been recorded. The great cure for all this, both as regards hauliers and trappers, would be to adopt the use of steam-power and tail-ropes, or endless ropes, according to the adaptability of either process to the thickness, angle, and other conditions of the beds of coal, and the strata in which they repose.

Utility of Scientific Instruments in Collieries.—Returning to his observations in a previous report, Mr. Brough remarks that there should be a barometer in the cabin within a reasonable distance of the bottom of the pit, and a record of the height of the column should be kept day after day, and in fact at all times. Meteorological disturbances are reflected more or less in the weather glass, which rarely fails to give us visible indication thereof. On the day of the Ferndale calamity the barometers stood at 30·60 (the highest record of that year), and according to all previous precepts we should certainly not have expected explosion with so dense and compact a state of the atmosphere; still, perhaps, this exception may contribute to the proof of the soundness of the rule that the barometer may be entirely relied on, for there had been considerable oscillation in the column of mercury about then and for some time previously, and storm and tempest had swept over the country, and indeed over all this quarter of the globe. Years ago outbursts of fire-damp were looked for in the summer, and so they are at the present day, and very proper it is that they should be watched for, and due provision always kept in readiness to dispose of them with plenty of fresh air. Those hot months are always to be apprehended, and are necessarily periods of great anxiety; but it is worthy of note that some of the most disastrous of all explosions have occurred in the winter time; Risca, the Oaks, and Talke-o'-the-Hill were all in December, the Cothin and Ferndale were both in November, and the Morfa was in October; and, in fact, others of these great national calamities took place late in the season. The difference of month by no means detracts from the merits of the barometer; on the contrary, it rather enhances its value, for whenever the mercury is moving rapidly down or up, we may be assured that disturbing causes are in action, and we should accordingly exercise every precautionary effort in our power. Too rapid ascension, quite as much as very sudden depression, indicates a startling change in the condition of the atmosphere, whatever be the period of the year. The utility of scientific instruments is undeniable, but there are others besides spirit levels, theodolites, and circumferentors; for example, the barometer, as already stated, the thermometer, the anemometer, and the water-gauge, all of them of great value indeed. Eudiometers and sympiesometers we can do without; the former is to facilitate the analysis of the amount of oxygen in the atmosphere, but that for the present is not in use amongst viewers. As regards mere fire-damp, if we wish to ascertain the bulk that is present in a stall, or the far end of a level or heading, we can get at that by testing with the safety-lamp, and then by measuring the cubical contents of the place under examination. It may be thought a rude method, but by it we approximately arrive at the object in view—in fact, generally, quite near enough for our purposes. The sympiesometer we do not require at all; inasmuch as that the class of barometer we use underground is infinitely superior to any sympiesometer ever yet manufactured.

PRICES OF MATERIALS,

As charged at Providence Mines during the following months:—

Description.		April.		May.		June.	
Common iron	per cwt.	8s.	0d.	—		—	
Hoop ditto	„	12	0	—		—	
Borer cast-steel	„	45	0	—		—	
6-inch patent nails	„	19	0	—		—	
5-inch ditto	„	19	0	—		—	
4-inch ditto	„	20	0	—		—	
2-inch C. S. clout ditto	„	35	0	—		—	
Steel point shovels	„	—		—		38s.	0d.
Leather, butt	per lb.	1	6	—		—	
Norway timber	per foot	0	8½	0s.	8½d.	0	8¼
Coals, M.C. (contract)	per ton	12	4	12	0	11	5
Best candles (carriage free) p. doz.		5	4	5	6	5	6
Tallow (ditto)	per cwt.	—		47	6	—	
Colza oil (ditto)	par gal.	4	6	—		—	
Powder (ditto)	per 100 lbs.	—		33	0	—	
Safety fuse (ditto)	per coil	0	4	0	4	0	4
Rope (ditto)	„	44	0	—		44	0
Hemp (ditto)	per lb.	5	4	—		—	
White yarn (ditto)	„	0	5½	—		—	

THE BRISTOL COAL FIELD—No. II.

ASHTON VALE COLLIERY.

A remarkable feature in the Bristol coal field is the succession of formations above and below the coal measures in regular order. Above the coal measures are found the Lower Oolite, Lias, New Red Sandstone, with magnesian conglomerate; and below are found the Millstone Grit, Carboniferous Limestone, and Old Red Sandstone, in regular succession. To sink through the overlying formations to the Deep coal measures would require pits of about 2000 yards depth; this depth could only be reached by a succession of lifts of about 600 yards each. Pits of this depth, experience has proved, can be worked with safety. This depth (6000 feet), it must be observed, is much beyond the limits which have been assigned as the workable depth of coal. The Bath Oolite, overlying on the eastern side of the Bristol coal field, causes the boundary to be unknown in that direction; but the steep and almost vertical position of the coal seams at Vobster, and the steep inclination at Twerton Colliery, have induced a belief that it soon terminates under the overlying formations. Looking at the position of the Bristol coal field with regard to the different overlying formations, there is no reason to doubt the existence of coal measures under each one of these formations, which may overlie at the surface in any other part of this country; and the same remark will apply to the existence of coal seams under the chalk formation. The probability of finding them in these unexplored regions could only be determined by a series of borings on an extensive scale. There is a probability of one or more of the series of rocks being wanting, thus lessening the depth to the usual position of the coal measures, as is notably instanced in the Belgian coal field, which lies in some parts close under the chalk. The South Wales coal measures are not covered by any overlying formation. The South Staffordshire, Shropshire, Nottingham, and Cumberland coal fields are covered by the Permian rocks at their eastern or western sides, or both; and the coal seams have been supposed in all these to be cut off by large faults, but recent discoveries of coal under Permian strata have modified this opinion. The Durham coal field is supposed to be cut off on its southern side in a similar manner, but on the eastern side coal is worked under the Permian strata to a great extent, without any deviation from its regular inclination, or deterioration in quality. In the southern portion of the Bristol coal field the upper series of seams are worked in the Radstock district. There are six seams, the aggregate thickness of those workable is 8 feet. The series below (upon the Pennant rocks) contains four workable seams, and 10 feet of workable coal. This group corresponds with the upper seams given in the northern portion of the coal field. The Radstock group are supposed to be denuded at that end. Both these series furnish bituminous coals, suitable for household purposes. The lowest series of coals below the Pennant rocks are worked at Ashton Vale, Nailsea, Vobster, and Twerton Collieries; their aggregate thickness is about 60 feet, ranging from 3 to 6 feet each, and several under that thickness. Seams of 12 in. are worked in some parts of the coal field, where a bed of fireclay and other conditions combine to render it a profitable working.

Ashton Vale Colliery is situated about 2 miles south from Bristol, and the royalty is leased by the Ashton Vale Coal and Iron Company from Mr. Smith, being about 800 acres in area. The new pit, 12 feet diameter, is sunk to the Great vein, is walled throughout—4 yards of walling above the surface, 7 yards of clay, 21 yards 2 feet of New Red Sandstone and magnesian conglomerate; below that the coal measures. Depth to Great vein 213 yards. The Top vein is 16 yards above the Great vein, and another seam, worked for fireclay, is 41 yards below. The pit is fitted up for two cages, each holding two tubs on a level; two wood guides for each cage, fixed to wood buntons; one winding-engine, with two horizontal cylinders 27 inch diameter, 4 ft. stroke, high pressure, 12-ft. drum, between the cranks, all under cover in the house; two 1½ in. round wire-ropes—top rope will endure two years, or more, bottom rope about 18 months. The old pit, about 250 yards to the west from the new pit, is 6 ft. diameter, 224 yards deep, and is used solely as an air pit. One of Lemielle's ventilators is erected near the top of it, and exhausts 14,200 cubic feet of air per minute from the colliery, with a 2-inch water-guage pressure. The engine and ventilator at present are going 48 revolutions per minute, but the speed has been somewhat reduced, owing to the shaft of the ventilator being out of order; it has been driven at a much higher rate. The ventilator is 8 ft. high, placed in a 12-ft. chamber, has three wings, and has worked satisfactorily for five years. The engine driving it is 14-in. horizontal cylinder, 2 ft. stroke, 25 lbs. steam pressure, direct acting to ventilator; one boiler.

A vertical beam-engine, 20-horse power, erected at the old pit, grinds clay for the brick works, and is used for drawing the men up this pit in case of an accident to the new pit; condensing engine; one boiler.

From the bottom of the new pit levels are extended to the east and west in the Great vein; the workings to the west are most extensive. Drifts are driven across measures to the south, about 48 yards to the Top vein, at two points.

Section of the Top Seam, Face of West Levels.

Cliff, or shale roof.		Black shale	0 ft. 6 in.
Ironstone	0 ft. 2½ in.	Coal, top vein	3 ft. 3 in.
Shale ground	1 ft. 0 in.	Fire-clay	3 ft. 0 in.
Ironstone	0 ft. 2½ in.	Hard fire-clay.	
Shale ground	2 ft. 0 in.		

Holing is made in the coal. The coal is sent to bank mixed, none left underground. The ordinary price paid to the collier is 1s. per ton when the coal is right, but it is subject to jumps and rolls, and irregularities in thickness, for which an allowance in price is to be made. The extraction of coal is conducted by a phase of long work differing from those before described. The level, or "head," is driven 32 yards wide in a west direction. The road-way is made through it 6 ft. square; below the roadway 8 yds. of coal are extracted, and 22 yds. above it=32 yds. in all. By this plan there is no previous driving out of levels; this breadth is got in one operation. Above this breadth another head, 32 yards wide, is driven in the same direction, with the road-way formed through the goaf in a similar position. The coal from this road-way is let down by self-acting inclines to the low road. Another breadth of 32 yards, above the second, is got by another "head," the coal from which is let down by self-acting inclines to the middle or low road-way. The inclines are constructed each with double line of road, wooden reel, and ⅞ inch chain. The average dip is 12 inches per yard south. The heads are not driven much in advance of each other, in order more easily to ventilate the different heads, passing the current of air from the lower to the upper one without forming any air-ways. No fire-damp is produced in these seams, black-damp is sparingly produced, and a small amount of ventilating current suffices the requirements of the mine. In each head three men and two boys are usually employed, who will send away 12 tons of coal per shift, when in its proper thickness; when irregularities occur less hands are employed. The boys bring the coal down or up by the face of work to the road-way in slide carts, where it is filled into large tubs, holding 8 cwts. of coal. After the coal is worked out, and the goaf stowed up with debris, the ironstone above is worked out by a separate working on the same principle, only the same road-ways serve for bringing out the ironstone as were used for the coal.

Section of the Great Vein.

Good roof, shale.		Coal, Great vein	3 ft. 6 in.
Ironstone, irregular	0 ft. 2 in.	Soft clay	1 ft. 0 in.
Shale ground	2 ft. 0 in.	Hard fire-clay.	

The holing is made at the bottom of the coal, and is all sent out mixed. The mode of extraction is the same as that described in the Top vein. The Great vein has a better roof, and the main roads are maintained in that vein, stone drifts being driven to the Top vein at suitable points. About 60 men are employed as colliers in the two veins, who cut and fill the coal, with the assistance of the boys, and set the timber; there are other men, about half that number, who are engaged in the night shift, in stowing up the hollows or goaf after the colliers have extracted the coal. The pit commences drawing coal at 6 A.M., stops at 5 P.M.; colliers commence at 6 A.M., leave at 3 or 4 P.M.; night-shift men commence at 10 P.M., and leave at 6 A.M. About 200 tons of coal per day are got from the two seams; there are two overmen in the day turn and two at night; five horses are employed underground, but a large proportion of the tramming is done by hand labour.

The Great vein produces the best coking and steam coal; the Top vein produces the best house coal, does not coke of itself, is mixed with the other coal for coke making. The small coal is washed by mechanical process previous to being coked. There are four short coal screens on the bank; the produce is about half large and half small coal. There is not a great production of water at this colliery. The water is drawn in the night turn by the winding-engine, with iron cisterns running in the guides. A vein of fire-clay of good quality is wrought and manufactured into fire-bricks, and reached by a stone drift driven north from the Great vein. The air for ventilation is divided at the bottom of the downcast into two currents, one west, the other east. Each current ventilates its respective workings without further subdivision. The intake and return, on the western side, are separated for a considerable distance by a breadth, or 32 yards of goaf, through which air will, no doubt, leak to a considerable extent, and will diminish that which should be divided and pass through the working places. Two new pits have been commenced in this royalty, a considerable distance south-west from the present coal pit. They are intended to be sunk to the Bedminster seams, and are estimated to be 450 yards deep. One downcast for coal drawing and pumps, 13 ft. in diameter; one upcast, 10 ft. in diameter. Bedminster Colliery, adjoining Ashton, and the only one in the neighbourhood, works two seams, the Top vein and the Great vein. At present the produce of coal is limited to about 50 tons per day.

One blast-furnace is in operation at Ashton Vale; the make of pig-iron is about 120 tons per week, No. 3 hot-blast; the ores used are the mine from the Top vein, mixed with that from Barrow, in Somerset. Coke is used in the furnace: 32 oblong coke ovens are at work. The coke is drawn by a cradle and winch; a short chimney is built to each. There are also 12 patent coke ovens built in a circle, with a tall chimney, at work, and other 12 of the same construction not in operation. The coke from these is smaller in size and less dense than that made from the oblong pattern.

Rolling-mills capable of making 300 tons of bar and plate iron per week are erected; at present these are not in operation, owing to the depressed and unremunerative condition of the trade. The cost of these mills is stated to be 46,000*l*. The Bristol coals, it is observed, are without divisional structure, breaking up into irregular-shaped pieces. It seems to be unimportant in what direction the coal is worked, though the Ashton Vale seams are always worked westward or eastward. The prices of coal at Easton Colliery, near Bristol, are as follows:—House coal, large, 13s. per ton at the pit; ditto, second size, 11s. 6d. per ton at the pit; half-and-half coal, 10s. per ton at the pit. Carriage to the central parts of Bristol 2s. per ton more.

THE EARL OF DUDLEY'S COAL AND IRON WORKS.

MR. GRIFFITHS IN THE BLACK COUNTRY.

The result of a recent inspection of the immense coal and iron deposits, together with a description of his lordship's iron works at Round Oak, which gives employment to 8000 pair of hands and 200 steam-engines, may be interesting at the present moment. The improved manufacture of iron is of paramount importance to the country, the more so because of the fierce competition which the Black Country, North Staffordshire, Middlesborough, and Wales have to contend with in continental markets from the Austrian, Prussian, but more particularly Belgian manufacturers; a sketch of this famous establishment may be interesting, from its intimate connection with this important branch of national industry.

His lordship's iron works at Round Oak are situated on the high-road between Dudley and Brierley Hill, and are, without doubt, the most complete in South Staffordshire, regularly turning out a quality of iron unrivalled by, if not superior to, the production of any works in the Black Country. We arrive at this great establishment by the West Midland division of the Great Western Railway, which runs parallel with one angle of the works. A canal connects it with the North-Western Railway, and twelve locomotive-engines are employed to serve these works, thereby rendering assistance also over 40 miles of railway, which traverse his lordship's collieries. The works, together with the offices, &c., cover 30 acres of land, and they are capable of turning out from 500 to 550 tons of best finished iron per week. There are nine steam-engines in the mills and forges, all working vertical or horizontal, and a very large steam-hammer, with the last improvements, which is capable alike of dropping a 20-ton blow or cracking a nut without bursting the kernel. Here they have four large forge hammers or helves, and this is the only method adopted to form the puddled balls into blooms or slabs, as they may be required. Old-fashioned shingling is the practice here; neither squeezers nor patent shingling of any kind is resorted to. There are five rolling-mills—one 16-in. plate mill, a 12-in. ditto, an 8 and 7 in. bar mill, with a good hoop-mill; and the space allotted to the hoop-mill and the fencing wire-mill—indeed, all the mills in these works—is admirable for its extent and convenience. The speeds are higher than anything in South Staffordshire, and the machinery, by its quiet and steady motion, forcibly reminds one of the regularity of clock-work. We have no hesitation in saying that the construction and perfection of the gear which drives all the mills and forges supersedes anything we have seen in this or any other country. The wheels, when in full work, make very little noise; the driving-wheels are large, and as the engines run fast the nut on the fly-shaft of necessity is very rapid, but the sound resembles the gentle murmur of the crabwood gearing of a flour-mill rather than the unremitting contact of metal with metal in their constant revolutions. We hear no banging sounds like a sledge-hammer on the cog of a wheel which are generally heard in the iron works of the Black Country. We were much struck with the truth of all the driving-wheels; indeed, the general lines of the work reminded us of a parallel, always square and rightly placed. We could not help observing the scientific distribution of metal in the numerous wheels and shafts. Even those unwieldy blocks of metal called cam-rings were shaped with a view to a scientific distribution of the iron, and the engineer, while exercising economy in this respect, had not forgotten the ornate. There are 53 puddling-furnaces, nine ball-furnaces, and two heating-furnaces. The fettling used is ground bull-dog only. Neither pottery mine nor hematite ore is permitted in the works.

The bull-dog is calcined exclusively from the taps of the puddling-furnaces on the spot. The puddling-furnaces are fixed at equi-distance from the hammers, and as the interior area is completely laid with square plates, the roofing being sustained by a very high wall plating on columns all round, the works present a clean and comfortable aspect, and must be comparatively cool in summer time, which is a great desideratum.

A railway serves the coal and removes the ashes from the back, while a second railway deposits the pig-iron and ground bull-dog on the standings at the front of the furnaces. The kilns for calcining bull-dog are fixed at equi-distance between both works, and a railway takes the taps from the works to the kilns, returning loaded with the ground fettling for the puddling-furnaces, which struck the writer as a very perfect and economic arrangement for this otherwise dirty and expensive process. The last erections here are the new forges, situated a few hundred yards from the old mills, containing 28 puddling-furnaces, fixed round the works in the shape of a horse-shoe, being ministered to by two large forge-hammers, which are driven by two vertical-engines, 55-horse power each; each engine driving a hammer, forge-rolls, &c., *per se*, so that the motive-power of the one is disconnected with, and entirely independent of, the other; the engines, driving-wheels, rolls, &c., being fixed parallel with the heels of the horse-shoe figure of the forges, a space is left between the driving-wheels, and the engines being fixed underground, but everything as firm as a solid rock. The puddling-furnaces are served with coal, metal, &c., by rail, back and front, as described above, and the puddled bars, billets, &c., are removed by rail, with locomotives, into the mills, which are at some little distance, for consumption.

We have been particular in describing these forges, believing, as we do, that they are model forges, and that there is nothing in this or any other country which can equal them in all that relates to engineering design, excellence in structure, and repleteness with all those facilities in a forge which render the manufacture of iron more healthy and easy for the men, and at the same time, in manipulation give greater strength and uniform perfection to the article produced. It must be observed here that the whole of the pig-iron or plate-iron consumed is made from the Earl of Dudley's mines, raised on the estate, and smelted at his own blast-furnaces. Nothing is used but his lordship's 10-yard coal, which is doubtless the best in the world

for the manufacture of iron. No foreign pigs of any kind are permitted in the works, hence the famous quality of the iron produced.

These great works are justly famed for the manufacture of large rounds and squares. Rounds are rolled here as high as 6¼ in. diameter down to 7-wire gauge; and the higher sizes of rounds are in general request at the machine shops of the kingdom for piston-rods, owing to the compactness and superior quality of the iron rolled here. Boiler-plates are made with facility, of large size, up to 18 cwts.; angle bars and T-iron of great length are made, from 6 in. by 6 in. to ⅝ in. by ⅝ in.; flats of all thicknesses, from 12 in. down to ½ in. wide; an unequal size of angle iron, from 8 in. by 2½ in. down to 2 in. by 1 in.; likewise channel iron, from 3½ in. to ⅝ in.; glan iron, ovals, round-edged flats, core bar iron, bevel iron; Z-iron, or, in other words, double-angle iron; square-edged and feather-edged iron, boat-guard iron, shutter iron, great bar iron, with various other specialities too numerous to mention. Here likewise the famous U-iron is produced, which up to this time has not been rolled at any other works in England. Rails of a very superior quality are likewise manufactured here, for the rolling of which the works offer great facilities. A layer of steel is welded on the top of the rail, the web or foot being made of his lordship's best fibrous iron, which is said to give greater strength and durability to the rail than the steel rail made in other districts.

The Earl of Dudley's iron stands quite at the top of the Staffordshire makes, and posseses all those peculiar qualities which have rendered Staffordshire iron so famous throughout the world in a more eminent degree than any other maker. This mainly arises from two causes—first, the splendid 10-yard coal, so abundant in his lordship's estates; and, secondly, the superiority of the earl's argillaceous ironstones found west of Dudley. The iron produced here is consumed by shovel and spade makers (in plating bars), for horse-shoes, rivet-iron, cotton-rollers, gun-barrels, bayonet-iron, saddlers' ironmongery, for wire-drawing purposes, locomotive-engines, and agricultural machinists' purposes. Its tension while hot in punching is marvellous. It is likewise used for all bright work, easily polishing without specks, and for other specialities, which renders its adoption desirable where it can be obtained.

The Earl of Dudley's finished iron is largely consumed at the great engine-shops on the banks of the Neva, in Russia, and is sent to Canton, Foo-chow-foo, and Pekin, in China—to Hokudadi and Yokohama in Japan—Cabul and Candahar, in Affghanistan—and even the almost unexplored regions of Thibet are supplied, *via* Cashmere, with some particular kinds of iron from these famous works; and pig-iron with his lordship's brand was found in Theodore's cannon foundry in Abyssinia, which must have been carried for some hundreds of miles on the backs of the attenuated mules of that country. The superiority of this marvellous iron is owing, no doubt, to three or four circumstances. In the first place, all other makers buy different mixtures of pig-iron. The Earl of Dudley makes at his blast-furnace establishments the best iron that can be made out of the materials raised in his own estates, and consumes these pigs, and no others, at the Round Oak Works.

Secondly, all thick coal is used, which is the very best for the purpose, and as his lordship has untold wealth, ungotten in coal, in the earth, he uses the best quality of this, and no other. Thirdly, neither pottery, mine, nor red ore are used in the puddling process. Fourthly, and lastly, the puddling process is manipulated to perfection by the very best puddlers, and the management, backed with his lordship's wealth, is of the very highest order, and reflects credit on the manager-in-chief, which the Earl of Dudley has reason to be proud off. The Earl of Dudley's mineral wealth is priceless, and comparatively inexhaustible, extending over thousands and thousands of acres of land, which beneath the surface of the earth, particularly on the west side of Dudley, contains the choicest and the richest argillaceous ironstones in the world. These estates yield in abundance blue flats and balls, Oldbury white stone and rich gubbin, pins, grains, and robins in perfection, together with several other argillaceous deposits of iron found on no other estate in the world. His lordship has three blast-furnaces at Conigree and four at the Level, all constructed and worked on the most scientific principles, the smelting process being conducted more with a view to give an excellency of of quality than an abundance in quantity. The pigs manufactured here were formerly sold to the leading makers of South Staffordshire, but, as may be supposed, the best quality of his lordship's make is now consumed at the Round Oak Works. In the collieries and lime works there are now in regular work on coal, ironstone, limestone, and fire-clay, 160 pits; but it must be observed here that no adequate opinion of the enormous quantity raised can be formed from this data, as the excavations and immense galleries in the 10-yard coal workings extend over vast areas in these pits, employing large numbers of men and horses; indeed, these underground workings are so extensive as to put one forcibly in mind of the vast catacombs of Rome, while the solid walls of coal, 10 yards high, by which these underground caverns are bounded reminded us instantly of the perseverance and labour which cut the lava from the walls of the theatre, and exposed this ancient edifice to the view of those who have the opportunity of visiting the scorched city of Herculaneum.

The Round Oak Works was founded by the late Mr. Richard Smith, who for 30 years was faithfully and successfully engaged in developing his lordship's coal and mineral empire. The tact, talent, and transcendent business abilities of the late lamented Mr. Smith were well known and appreciated in the iron trade. Mr. Frederick Smith, the present manager, is a gentleman and a scholar, a fellow of St. John's, Oxford, but obtained immense practical knowledge under the guidance of his late father, and as he inherits the business qualities of his father, the efficiency of the management continues unabated, probably a greater willingness is evinced to adopt all modern improvements, and adapt these great manufacturing operations to the requirements of the day, keeping abreast in all departments with the rapid progress of the iron age in which we live. S. Griffiths.

SLATE QUARRYING IN AMERICA.

A correspondent, writing from Upper Mount Bethel, Northampton county, says—The slate business has of late years made rapid progress in this section of Pennsylvania. New companies have been formed and new quarries opened, until now there are fully a dozen quarries in successful operation in the eastern part of Northampton county. Owing to the fact that shingles are not so plentiful nor so cheap as in former years, the demand for roofing slate has rapidly increased, and has given a new impetus to the slate business. Most of the quarries in this county are worked to the utmost capacity, and yet the supply is not equal to the demand. Roofing slate is sold at the quarries at from $5·50 to $7 per square according to quality. A "square" contain 100 square feet. School slates (rough) are worth $16 per thousand at the quarries.

The following are the names of the principal quarries and the average number of squares" taken out per day:—Jorey, 20 squares; Pennsylvania, 100; Ames, 20; Hughes, 30; Bray, 20; Bangor, 50; Hageman, 20; Williams, 20; Delaware, 10; and Chapman, 150 squares. The first five named quarries are situated near Delpsburg, about seven miles from the Delaware river; the Bangor and Hageman at Uttsville; the Williams and the Delaware near Slateford, and the Chapman at Bath. The Williams is said to be the oldest quarry in the United States, and has been in operation nearly 70 years. Mr. J. Williams, the proprietor of the quarry, is a Welshman, and came to this country many years ago. Mr. Williams is a whole-souled, clever old gentlemen, generous to a fault; and although he is not ambitious, and has never worked in his quarry with a view to amassing wealth, has accumulated considerable property and money. A few days ago he was offered $50,000 for his quarry by some Eastern capitalists, but he avers that he will not take less than $80,000, as the slate is inexhaustible. He has only a few quarrymen at work, but, with his free and easy way of working the quarry, his profits amount to $80 per day.

At Slateford, which is situated on the Delaware, near the Water Gap, there are two school-slate factories. At Mount Bethel Station, a few miles below, there are three factories. I am told that the market for school-slates is overstocked just at this time, although the Ames Company, which has contracted to furnish slates for the freedmen's school, are doing a brisk business in this line. Mr. Ames, the chief of this company, is a brother of Oakes Ames, M. C., from Massachusetts. As might be expected, there is a good deal of prospecting for slate at this time, and slate property frequently changes hands. As an indication that speculation is rife, I heard a few days ago that some 30 acres of land, on which there were indications of slate, was sold to a party for $4000, and the next day was disposed of to another party for $15,000.

The slate is generally found in large layers or blocks 10 or 12 in. in thickness. It is then divided into smaller blocks of convenient size, and with a chisel and mallet is split up into roofing and school-slates. The best quality is always used for school-slates. The miners or quarrymen are generally natives of Wales or England, and are employed because they were familiar with the business in the old country. A good quarrymen receives from $3·25 to $3·50 per day.

The opening of the Delaware, Lackawanna and Western Railroad, with its connections, has afforded the proprietors of quarries an opportunity to send their slate to distant markets. A route for a new road has been surveyed from Easton to Delpsburg, and another from Bath to Uttsville, and from thence to the Delaware river, to intersect with the Delaware, Lackawanna and Western Railroad

The roofing slates are sent to all parts of the country. The Pennsylvania Company transport their slate to New Orleans. Besides roofing and school-slate, solid blocks are also shipped, and used for door-slabs, pavements.—The "slate belt" extends along the eastern base of the Blue Ridge Mountains, not often beyond 8 miles from the summit. It extends eastward into New Jersey for 20 or 30 miles, and southward to North Carolina. There are several quarries in successful operation in Buckingham county, Virginia.—*Washington Express.*

FOREIGN MINING AND METALLURGY.

The exports of coal from Belgium during the first seven months of this year amounted to 1,993,226 tons, against 1,930,373 tons in the corresponding period of 1867, and 2,198,570 tons in the corresponding period of 1866. It results from this comparison that the situation is better than it was last year, but that it is still not up to the mark of 1866. The exports of coke from Belgium present less satisfactory results, regarded from a Belgian point of view, having fallen in first seven months of this year to 300,638 tons, as compared with 318,400 tons in the corresponding period of 1867. The imports of coal into Belgium in the first seven months of this year amounted to 157,522 tons, against 238,586 tons in the corresponding period of 1867, and 62,901 tons in the corresponding period of 1866. The condition of the Belgian collieries is considered to be improving; the extraction has sensibly increased, and the number of pits remaining inactive in the basin of the Couchant de Mons is decreasing; notwithstanding, too, the constant increase in the extraction, stocks have been somewhat reduced. The coalowners cherish the hope of an early advance in prices, but it is not very probable that an upward movement will take place until stocks have in great part disappeared, and this is far from being the case at present. Freights are maintained at Charlerol at 7s. 6d. per ton for Paris, and 8s. per ton for Rouen.

The progress of metallurgy in France during the last 50 years is forcibly illustrated when we go into figures. Thus in 1820 the production of pig was 110,000 tons; in 1830, 266,361 tons; in 1840, 347,774 tons; in 1850, 405,653 tons; in 1860, 898,353 tons; and in 1866, 1,253,100 tons. As regards iron, it was made in France in 1820 to the extent of 75,000 tons; in 1830, to the extent of 148,469 tons; in 1840, to the extent of 237,478 tons; in 1850, to the extent of 246,196 tons; in 1860, to the extent of 532,212 tons; and in 1866, to the extent of 811,900 tons. The rapid progress which may be remarked during the last 15 years is attributed to the increased importation of coal, but the increased use of coal has been a cause of suffering to the owners of works employing vegetable combustible. Thus, while in 1852 263,340 tons of pig were made with vegetable combustible, and 259,303 tons with mineral comtustible, the corresponding figures stood in 1864 as follows:—Pig made with vegetable combustible, 224,510 tons; ditto made with mineral combustible, 988,241 tons. To illustrate the matter further, it may be stated that in 1845 France possessed 353 blast-furnaces working with vegetable combustible, 46 with mineral combustible, and 33 with a mixture of the two combustibles. In 1864, 143 blast-furnaces previously worked with vegetable combustible were in idleness, while the number of furnaces worked with two combustibles had increased by 50, and that of blast-furnaces worked with coke alone by 91. We might add other figures to show that it is the same with iron, properly so called.

The Council-General of the Bank of Naples has been authorised to determine an application for a loan made by the metallurgical establishment of Pietrarza. The sum for which the shareholders apply is 56,000*l.*, which is to be secured on mortgage of the premises, which belong to the Government. The works were transferred to a company of shareholders in 1863, the company being constituted with a capital of 120,000*l.* During the five years which have elapsed since 1863 great works have been carried on, which have afforded abundant employment to the iron trade; and when we see the Pietrarza establishment have recourse to a loan, we can but deplore the position to which it has been reduced, since it would appear that the share capital has been absorbed.

The condition of French metallurgy is considered to be sensibly improving. The demand for merchants' iron, sheets, and machine iron is very well sustained, and the rolling mills producing rails have large orders on hand, as was shown by a recent recapitulation. Pig, however, which has been neglected for some time, does not share in the upward movement which has taken place in iron; charcoal-made pig is quoted nominally at St. Dizier at 4*l.* to 4*l.* 2s. 6d. per ton. In the Moselle, pig for refining is in tolerable demand, and some marks are placed at 2*l.* 10s. 6d. per ton; but in this district, as in all the French groups, it is iron works which appear to the most advantage. On the Paris market prices are supported with great firmness. A sale has been effected of the Herscrange Iron Works, Forges, and Blast Furnaces; the upset price was 6000*l.*; a single bid of 4000*l.* was made by Baron d'Adelsward, who was declared the purchaser, subject to any higher terms being offered within a period of forty days.

The metallurgists of the Charleroi group continue to make lengthened complaints to the Minister of Public Works on the subject of the new goods tariff which has been brought into force since the commencement of this year by the Administration of the Belgian State railways. The Minister has turned at present a deaf ear to these complaints. Commencing with this month a new Franco-Belgian tariff has been brought into force; this tariff presents fresh augmentations in the rates charged for transports towards France. The rise of 4s. per ton in iron which was recently attempted by some Belgian forgemasters seems to be acquiring some consistency; and, upon the whole, the price of iron would seem to display a firmer tendency. It is not the same with large plates, which are dealt in on various terms, and on conditions often securing but a small profit to producers. Sheets have been in good demand, and have displayed a strong upward tendency. No further orders of any extent appear to have been yet received in Belgium on Russian account; on this head it may be observed that new works for rolling rails which an English company has been establishing at Vyksa, in the Government of Nijni-Novgorod, in accordance with a contract concluded with the Russian Government, will be soon in full activity. These works comprise modern mechanism of 300-horse power, and they must be regarded as presenting a serious competition against Belgian industry. The market for pig continues to be in a somewhat languishing state in Belgium, under the influence of a considerable stock.

In the first seven months of this year the exports of pig-iron from Belgium amounted to 10,509 tons, as compared with 7082 tons in the corresponding period of 1867, and 10,404 tons in the corresponding period of 1866. This movement is all the more remarkable when we consider that the imports of pig into Belgium in the first seven months of this year amounted to 34,548 tons, while in the corresponding period of this year they were only 24,532 tons. Of the pig imported into Belgium, the greatest part comes from England, 21,186 tons having been received from Great Britain in the first seven months of this year, as compared with 31,600 tons in the corresponding period of 1867. The exports of rails from Belgium in the first seven months of this year amounted to 38,574 tons, as compared with 59,805 tons in the corresponding period of 1867, and 36,921 tons in the corresponding period of 1866. The falling off in the exports of rails this year must be attributed to the diminished deliveries made to Russia, that great empire having only taken 28,415 tons of Belgian rails this year, as compared with 51,565 tons in the corresponding period of 1867. The exports of plates from Belgium in the first seven months of 1868 amounted to 7552 tons, as compared with 7685 tons in the corresponding period of 1867; these figures show a sensible diminution as compared with the corresponding period of 1866, when 10,250 tons of Belgian plates were exported. As regards merchants' and other iron, there is some progress, 39,878 tons having been exported in the first seven months of this year, as compared with 31,143 tons in 1867, and 33,622 tons in 1866 (corresponding periods). An important order for iron rails (17,000 tons), required in connection with the construction of a Hungarian railway, is stated to have been given out conditionally to a Belgian establishment—that is, subject to the reservation of its being accepted by the Hungarian Government. The price named in connection with this contract is 7*l.* 4s. per ton, delivered at Trieste. A somewhat similar order was recently given out to a French establishment at 8*l.* per ton, also delivered at Trieste.

NOTES ON AN EXCURSION OF THE MINERS' ASSOCIATION IN THE ST. JUST DISTRICT.

Through the kindness of the association, the members, were treated to their annual excursion to this far-famed, wild, romantic, and picturesque district; and one could not help noticing, as mine after mine came into view, in our 20 miles' ride, that where ores of much value had been raised the lodes were running parallel to the ridges of the hills, and that the top bunches of ore are mostly found in connection with depressions in the surface, branching from the main valleys in which the springs of the district discharge their waters.

The first mine visited was Wheal Owles, which is rather extensively worked; there are three pumping-engines and steam-whims, and one steam stamps, working 64 heads. The returns are about 20 tons of black tin per month. It is the practice here to stock their tin, of which they have now about 200 tons, waiting for an advanced price. The dressing contrivances seem to be very fair, and what struck us most was the large round buddle, 50 feet in diameter, and capable of buddling 1006 tons of stuff per month. The rock is granite. Lodes vary from 12 to 18 in. in width, chiefly underlying south. The stuff is sampled by the sack of 14 gallons, and average worth 2s. per sack or about 35 lbs. of tin to the ton of tinstuff.

We next come to Botallack, which adjoins, and here there is a splendid view of the North Channel, which, with the bold and precipitous cliffs, induced royalty to visit them. The mines are in granite and slate, and felspathic and hornblendic rock prevail. The sett is very extensive, and the principal workings are on six different lodes—Park Benny, Wheal Loor, Chycornish, Wheal Cock, Tolven, and Crowns. On the Crowns lode, Boscawen's, or diagonal, shaft is 240 fms. deep. Here six of the more adventurous went into the skip to the bottom of the mine under the sea, accompanied by Capt. J. Boyns, who showed and explained the various workings and dips of the mineral, &c. The lode underlies about 15 in. in a fathom, and it is very remarkable that if it underlies more the lode is worthless. Britton shaft is 185 fms. deep; Wheal Hazard, 100 fms.; Ranno shaft, 60 fms.; Chycornish, 100 fathoms; Engine-shaft, 205 fathoms.

There are four pumping-engines, six steam-whims, and one stamping-engine. The pitwork throughout the mine is small; 4, 5, and 6-in. pumps are used, consequently the water charges are light. Some very good specimens of tin, purple copper, brown hematite, magnetite, apatite, tourmaline, axinite, &c., were collected by various members of the class.

Five hundred persons are employed on the mines, their present raisings are about 35 tons of tin per month, and 300*l.* worth of copper. The labour cost and merchants' bills are about 1800*l.* per month, and the present returns will about meet the cost. About 84,00*l.* have been paid to the adventurers in dividends.

In these days of improvement too much attention cannot be given to tin dressing, and a good inspection was made in this department. The steam stamps is a 36-in. engine, 10 ft. stroke, with two boilers 21 tons, working 64 heads, the average height every head lifts is 8 in., and the number of strokes per minute is seven. There is a nicely arranged plunger, fixed at the end of the balance-box, to heave water for dressing. The stamp heads are cast and the lifter wrought-iron; these work four in one box or cover. At the back is an opening of 12 or 14 in., which admits the ore and water by an incline under the stamps heads; the work after being crushed is run out by what is termed flashes instead of stamps grates. This is done by damming back the water, so that the level is about 1 ft. above the sole of the stamps. Through this the work has to be forced up by the stamps, which always work in water and reduce the stuff very fine, and detach the black tin from the gangue and metallic impurities which accompany it in the stone. It is then run into round buddles, of which there are several; these divide the rough or crop from the slime tin; the slime is then conveyed to the frames, which are the ordinary ones in use, and after this it is cased and tozed until fit for the smelting-house. The crop tin after being buddled is tozed, and the process repeated until it is clean for the smelting-house. Zenner's patent buddles are used and well spoken of. Copper is associated with some of the tin, and mundic acid is used to destroy this troublesome neighbour. The cost of dressing from the stamps' grates is 13s. 4d. per 100 sacks, or say, 1s. 8d. per ton of stuff. The produce of the stuff is 40 lbs. of black tin per ton.

In closing my notes on this mine, I cannot conclude without thanking the purser, Mr. S. H. James, and the agents, for their kindness in accompanying us and explaining the various workings, and, after spending a pleasant day, we retraced our steps to Penzance, where the Breage class, through the kindness of the Messrs. Bolitho and their agents, inspected at Chyandour the different processes the ore goes through to be smelted into white blocks.—Wm. Argall.

NEW SAFETY-LAMP.

According to the invention of Mr. W. Key, of Bristol, the lamp is constructed of a metal case, with an orifice 3 inches in diameter, through which the light issues. The glass which fills this orifice is preserved from injury by several crossings of strong wire. The air is admitted through an aperture in the bottom, and the hot air goes out through another at the top of the lamp. Both these apertures are covered with wire gauze, protected in such a way as to put a stop to the dangerous practice of miners lighting their pipes through the gauze, which is often done with the lamps now in use. The lamp, made of common sheet-iron, would weigh about 2 lbs., and its price would not be greater than that of the Davy lamp, while it gives at least twice as much light, at a cost of about 2d. for 12 hours' burning. One difficulty with mining lanterns has been the breaking of the glass when it is brought into contact with the flame, but with Mr. Key's lamp the light goes out immediately the lantern is held in such a position as to bring the top of the flame under the glass. Held in any other position the light remains burning. Another peculiarity of Mr. Key's invention is that as soon as it is taken into an atmosphere of fire-damp the flame begins to flicker, more or less, according to the quantity of fire-damp, and eventually goes out. The lamp has been shown to several practical men, who highly approve of it. Altogether, Mr. Key's invention is a very ingenious and useful one, and likely to prove a great service to colliers in their dangerous calling.

THE MINES AND MINERALS OF MEXICO.

The mines of La Luz and Santa Lucia, which formerly yielded the largest amount of ore and of the richest quality in the whole Guanajuato district, were closed in the years 1856 and 1859 on account of the water rising, and, consequently, no profits being any longer obtainable from them; since that time they have only been worked upon a small scale and near the surface, without any large amount of loss being entailed upon their owners. Both the mines in question belonged principally to the Godoy family, resident in Guanajuato. The best part of both of the mines seems to have been worked out, for whilst La Luz gave 185,218*l.* profit in 1844, and reached a maximum of 262,490*l.* in 1848, it had gradually dwindled down to 2295*l.* in 1856, since which there has been an annual loss. So with Santa Lucia; the profit was 175,414*l.* in 1847, and reached the maximum of 467,985*l.* in 1849, gradually dwindling down to 7321*l.* in 1859, since which profits have not been realised. A little to the south of these mines, and situated upon the same lode as the La Luz, are those of Santa Clara and the Refugio, which are both worked by Mexicans, and as yet at a loss, notwithstanding that much ore has been extracted from them; and situated rather beyond the latter is that of San Vicente; this mine, although it has yielded large quantities of ore at times, has not yet supplied enough to pay off the original debt contracted upon it. In its immediate vicinity are the mines of La Trinidad and Jesus Maria, both contracted for by the United Mexican Mining Company; that of La Trinidad having been sub-contracted, and very extensive works having been carried on upon its territory, but with poor success; for, although the richest ore in the district is extracted from it, it is found in such small quantities that, up to this time, the mine is upwards of $200,000 in debt. Notwithstanding this, however, works are still being carried on, on a small scale, in the upper workings. The mine of Jesus Maria, on the contrary, is producing ore in considerable quantities—to a greater amount, indeed, than that formerly attained by either that of La Luz or Santa Lucia, but of a vastly inferior ley; still, it has yielded considerable receipts to the company, and, former liabilities having been paid off, is now just about paying the expenses of working it. Its yield is about 1400 cargas per week, but the ley is only 6 marcs per monton, with some gold disseminated in the quartz matrix. To the south of the two mines just referred to are situated those of Villarino, Santo Nino, La Purisima, and San Pedro; that of La Purisima having been formerly rich in ore, but being now in a poor condition, and with these mines what is denominated the "Luz District" on the south of the city of Guanajuato may be said to terminate; and to the north of it none of the mines which have been opened have proved to be very productive.

The Veta Madre district, particularly alluded to in my former report, which skirts the city from N.N.W. to S.E. at a distance varying from about three to less than one mile, contains many mines, as before stated, of which the best known are those of La Valenciana, Cata, Mellado, Rayas, and La Sirena, but which have been, for the most part, so much invaded by water as to admit of mere surface workings being carried on; somewhat more considerable operations being pursued in the working of those of Mellado, Rayas, and La Sirena than in that of the rest, but slender expectations of any very satisfactory result being attained. There are some other mining districts around the city of Guanajuato, but all are of minor importance. In the Oscura district the United Mexican Company are working two mines at no very considerable expense, as the returns have not as yet been sufficient to justify much outlay.

The advantages that would accrue, especially to mining interests in Mexico, were the various streams and mountain torrents which exist in many parts of the country turned to more account in the creation of motive-power for the reduction of the ores, which are so plentifully disseminated throughout the soil, has been pointed out upon previous occasions by Mr. R. T. Middleton, Secretary of Legation at Mexico; but the two or three attempts made in the Guanajuato mining districts, and at one of the haciendas de beneficio, proved of little utility, owing to the little care taken to dam up the water. A few years ago extensive works were projected upon the River Santa Ana, about three leagues from the city of Guanajuato, the intention being to cut off a large bend of the stream, which forms a peninsula at the point named, by means of a canal, and to convert the ground thus gained into a patio. The foundations for the dam, now abandoned would serve for a superstructure of vast proportions, and were the works completed upon a similar scale they would cost an enormous sum of money; and it is calculated that it would require a suppy of ore equal to at least the half of the whole amount at present available in the Guanajuato districts to keep them in operation. Notwithstanding, however, the unimportant results which have, until now, attended the attempts made to take advantage of the water supplied by the neighbouring mountains as a motive-power by the few owners of reduction-works in the Guanajuato districts, who appear to have turned their attention to the importance of availing themselves of natural resources so completely within their reach, it is probable that a stimulus to exertion in regard to a measure so important, and so especially calculated to benefit the interests of the whole mining community of this country, may be very generally created by the results which have been already realised by an English company, formed two years ago by Mr. McLaughlin McGown, for the purpose of reducing the ores of the Guanajuato districts entirely by means of water power, and which company has brought all the modern appliances of science into requisition in the carrying out of the undertaking upon which they are engaged.

The hacienda de beneficio, or reduction works of Burburon, in process of erection by the English company above referred to, and under the personal supervision of Mr. McGown, are situated at about 2 leagues distance from the city of Guanajuato, the works having

been commenced two years ago, a portion of them having been so far completed as to enable the operation of reduction to be carried on in them upon a limited scale during the last 16 months past. They are situated on the right bank of the River Santa Ana, which furnishes a plentiful supply of water from June to December; and amongst the works in progress is a large dam upon it, which will probably be nearly completed before the commencement of the next rainy season, and, when it be finished, it is calculated that a sufficient supply of water will be created to enable the reducing operations to be carried on at the works during the whole year, or very nearly so. The spot where the curtain is built is a narrow gorge, with high rocks on each side, and it has already attained a height of 34 ft. from the foundation, at the bottom of the ravine, to the summit; the water-course runs out at a height of 19 ft., and is carried along on the top of a wall of masonry to the reduction works, situated 2000 yards below; the water upon its arrival there having gained a fall of upwards of 90 ft., is utilised for turning two water-wheels, five arrastres, &c., and for supplying the lavaderos or washing-pits. The rates of reduction at the works at Burburon being less than those demanded at others in the district, ores of a lower ley than has hitherto been considered worth reduction may be operated upon there at a profit. The premises of the company consists of a patio 170 yards long, in which the montones of ore are deposited; and behind, upon a declivity, are the buildings containing the arrastres and lavaderos, the water-wheels, an assay office, an azogueria, or quicksilver warehouse, a weighing room, a blacksmith's forge, stables, a magistral furnace, sleeping rooms for the persons employed at the works, and office and counting-house for the manager, with a large water-tank behind the lavaderos; the whole being enclosed by a wall, and arms and ammunition, so necessary everywhere in this country, for 12 men, as well as some dozens of hand-grenades being constantly kept in readiness against any sudden attack of banditti; and Mr. MIDDLETON mentions with reference to the perils incurred by persons engaged in mining or agricultural, or any other pursuits within the territory of this Republic, which oblige them to reside in localities at all removed from the immediate precincts of towns or populous districts, that the resident partner at the reduction works in the immediate vicinity of those just described was taken by surprise by banditti at the beginning of the present year, carried round the premises with carbines pointed at his head, and forced to deliver up all the silver and money to be found.

Such a state of things, and which may without exaggeration be described as the normal and not the exceptional one, in this country, is not encouraging to the speculator, whether he be of foreign or native origin, especially since heretofore, even if he manages to escape the assaults of banditti upon his property, he is perpetually exposed to other attacks upon it in the shape of forced loans, ruinous contributions, and the system of wholesale spoliation, to which the necessities of the Government, for the time being, are eternally giving rise, rendering all calculations of profit and loss completely nugatory; and where no sort of estimate of liabilities can be formed, or the slightest clue to future eventualities be obtained, reducing all commercial operations to mere ventures, however solid may be the original basis upon which they repose, and however promising may be the material resources afforded by nature, if, as in mining, they be connected solely with the soil. The absence of means of communication throughout so large a portion of the Mexican territory, and the wretched condition of the few that do exist, is another great impediment in the way of industrial development in this country, and a more striking exemplification of this with respect to mining operations cannot be offered than by alluding to the fact that it is stated by an English gentleman employed upon the railway projected between the capital and Vera Cruz that if the line were completed the deshecho, now thrown aside as worthless, in the important mineral district of Pachuca, might be conveyed, all expenses of land and sea freight included, at the rate of from $25 to $30 per ton to Swansea, where it would be worth from $45 to $47 per ton for smelting.

A DESCENT INTO THE ROSARIO MINE IN MEXICO.

A correspondent writing from Pachuca, in Mexico, describes his descent and exploration of the celebrated Rosario Mine. He says:—

"Down 75 ladders, each 7 varas steep; down 40 compartments of gloom cut out of rock; in short, 1700 feet into underground night—this is the way we reach the bottom of the famous Rosario Mine. But, first of all, we go through a tramway projected into the mountain side for 100 varas or more, by which roads every car-load of metal is wheeled into daylight. Anyone who goes to bury himself in this lively sepulchre called a mine is bound to put on a droll suit of tomb-clothes they give him, the same worn by every resurrectionist here who digs. Countless rungs have to be trodden, and a great deal of precipitous rock passed by, before our main shaft opens on another level. There are excavations to right and left, but no new work visible as we grope through the rocky alley-way. Mules are pulling round a number of malacates, by which ore is taken up from the bottom of the mine. A malacate is sometimes called a horse-whim, and is a drum connected with a tall upright spindle shaft, from which, at right angles, project poles whereto mules are harnessed. Ropes go round the drum, and over poles a dozen feet high and as many apart, to the well of the mine. With the turning of the malacate by the mules one rope goes down and the other comes up, bringing a large cowskin full of ore or water. There are many of these malacates in the mine in the neighbourhood of the several shafts. As we go deeper the signs of excavation increase. There are strange vaults and chasms in the gallery through which we go; narrow openings here and there, up and down, where it seems that there had been a desire to follow up a streak of luck or to ventilate between levels; rises into Nox, winzes into Erebus. The rock, by the way, is porphyritic. The picks of the miners are now in hearing, remotely, and the faint sound of a blast comes upon the ear. Still deeper, the vaults and pits increase in size and blackness as we go along another level, and there are great spaces here hollowed out by pick and powder that would accommodate many congregations of miners. More winzes, more rises, more levels, are the order of the way. The winze is a small ventilating shaft struck down between levels, for want of which the miners would be badly off for the blast of life—but it is sometimes experimental also, and follows an indication of metal. We see here that winzes have been sunk to connect the level whereon we stand and the one below, and our attention is called to a rule in mining. Winzes connecting lower levels with each other are usually placed between the winzes cut through above, in order that a new direction of ground may be explored. If the ore extends through the level above, this part of the vein is laid open by an upward excavation or rise.

"There is a still a lower depth for him who enters Rosario; another level to pass; many more ladders to go down; accumulated darkness to undergo. But the bottom of the mine is reached, or rather we are next door to the bottom. Up and down in cavernous cuttings of the rock, the tawny native miners are at work. There is seemingly no end to the long, irregular, abutting, rugged, and spacious galleries in which they are boring. No level way exists here, wherefore we must clamber over rocks and planks till we can take hold of another ladder that directs us to the last pit, the last borings and diggings. They are about to blast at one of these some yards off, but out of sight, and ere we come upon the miners the explosion takes place with a sound of half suppressed thunder. This is the handsomest part of the mine—as a miner would say. It has stranger depths and rises, odder cavities everywhere. It is as yet unlevelled, unorganised into the regular proportions of the mine, and is the continuation of some mammoth caves, with pits, domes, and galleries in every order of disorder. We had to climb up rocks to a miner who was digging soft ore between in a nook so cunningly hollowed that folks up at grass would wonder. The miner may dig up, down, or on, but most do it all upon principle. When he bores or digs on into the rock he is making a stope. It is a principle that he shall not bring his house down on his head. So, between the arches or hollows made by his workings upwards he must leave enough rock to serve as a pillar for the superstructure. The miners appear by no means unhealthy men. The native miner will, like most of his craft, be a good workman if he is paid well. He works under bargainers, to whom a certain task, measured off, is let out for a third. The sub-miner receives at most $1 per day; the bargainer makes $4; hence there is natural complaint. The extravagant and partial wages sometimes paid have not had the best effect. A steadier, larger, more thriving class of miners might have been made by a more equable, economic policy at the outset. Nothing can be said against the worth of the English miners—a well-attested compact of bone, sinew, and skill, the world over. But it is time that the natives learned to dig out wages and bargains a little better than they make.

"The depth of the Rosario Mine, by ladders, is little more than 1500 ft.; but the distance thence to the surface by tramway is about 500 ft., and it is probably the same to the top of the hill of San Pedro by shaft. Thus is the Rosario deeper by its utmost count than the well-known mine of San Patricio, at Real del Monte, which is 540 varas, or 1600 feet. The mine of Dolores approaches to 1500 varas; but it is not possible that it can be so deep as the famous mine of Bohemia, which is no more than 3778 ft. What with its neighbour mine of San Pedro, the mine of Rosario must range underground for miles, or perhaps as great a distance as the journey underground from Moran Mine, at the Real, to the one on the Pachuca road, which is about four miles. The adit level being cut through in the Moran vicinity will increase the distance some miles. A great distance truly; though I have heard of a drain level in Cornwall 30 miles long, including its branches, and sometimes 70 fms. deep, where it had penetrated high ground. The shafts of Rosario, and its adjunct, San Pedro, are four. Shafts are sunk not only to take up metals, but especially to free mines from water, for after a certain following of the dip of the vein (generally at an angle of 45°) the work is stopped by water. By making nice calculations, and working away from the different levels underground, shafts may be sunk with more readiness than seams; indeed, there is an instance which, being worked from 15 different points, was completed in 12 months. Curiously enough, considering its age and depth, Rosario is a very dry mine. Formerly it has yielded $3,000,000 or $4,000,000 of product in a year, and though such good luck is not everlasting, still Rosario is the richest of these parts.

"Most of the pain and trouble of an underground journey is in the ascent. To get up 1500 ft. by wet ladders, steep as a wall, is equal to ascending in succession 12 Bunker Hill monuments on a hot day. After much panting and pausing on the grimy, narrow landings, we are within a few ladders of the tramway. Then an ill wind comes and blows out our candles. There is no help for it; we must grope up now through pitch blackness. With grunting and dubiety the ore-yard is at last regained. If angels go up the sky on Jacob's ladder on a very dark night this is about the time they will have of it, and I hope the rungs are all right."

SALES OF COPPER ORES.

COPPER ORES SOLD AT THE CORNWALL TICKETINGS FOR THE QUARTER ENDING SEPTEMBER 30, 1868.

Mines.	Tons.	Amount.
Devon Great Consols	5256	£21,642 16 6
South Caradon	1563	11,434 11 6
Clifford Amalgamated	2778	8,920 9 0
West Wheal Seton	1605	7,929 17 6
Marke Valley	1328	5,917 12 6
Wheal Seton	800	2,319 17 6
West Wheal Basset	470	2,254 16 0
South Crofty	741	2,238 18 0
East Caradon	553	2,125 13 6
Prince of Wales	374	2,094 14 0
Phœnix	543	1,947 19 6
Glasgow Caradon	597	1,931 5 0
Great North Downs	387	1,836 6 0
Wheal Basset	380	1,829 4 0
Carn Brea	397	1,773 2 0
Wheal Rose	449	1,731 11 0
South Frances	322	1,606 7 0
Poldice	390	1,558 1 0
Prosper United	922	1,539 11 0
Wheal Crelake	436	1,406 18 0
East Rosewarne	330	1,322 16 6
West Tolgus	346	1,255 17 0
Crenver and Abraham	502	1,242 4 6
Craddock Moor	248	1,235 19 0
Wheal Friendship	338	1,225 19 0
Wheal Maria and Fortescue	321	1,177 5 0
East Pool	455	1,163 12 0
North Treskerby	302	1,137 12 0
Gunnislake	206	1,022 15 0
Wheal Margery	379	939 7 0
Bedford United	369	908 14 6
West Wheal Damsel	246	891 8 0
West Caradon	211	821 8 6
Brookwood	203	779 4 6
Botallack	148	758 16 0
North Downs	125	708 13 0
East Carn Brea	256	677 2 0
Okel Tor	235	663 9 6
Devon and Cornwall	200	640 12 0
Emily Henrietta	124	616 18 6
Par Consols	148	566 0 0
East Wheal Russell	142	526 10 0
North Grambler	102	519 4 6
Copper Hill	163	518 19 0
Gawton	139	512 9 0
Great South Tolgus	149	452 8 0
Hingston Down	180	417 13 0
Falmouth and Sperries	66	356 19 0
Levant	46	348 15 0
Wheal Crebor	82	311 17 0
Carn Camborne	146	277 15 0
East Grenville	58	255 16 6
Dolcoath	34	253 6 0
Wheal Buller	59	249 1 0
Tincroft	62	241 12 0
North Roskear	50	218 15 0
South Condurrow	32	200 16 0
Belstone	37	185 17 6
Cawsand Vale	55	158 2 6
Gonamena	61	155 12 0
East Basset	31	151 3 6
New East Russell	38	151 1 0
West Great Work	26	141 9 0
North Pool	30	138 15 0
West Briton	28	128 12 6
Rosewarne Consols	26	114 12 0
North Crofty	22	103 8 0
Pendeen Consols	17	97 0 0
Champion's Ore	25	96 17 6
Old Gunnislake	27	96 10 6
Collacombe	18	95 17 6
Wheal Russell	36	79 4 0
South Basset	9	78 19 6
James's Ore	32	77 12 0
Wheal Grenville	10	73 5 0
Bughole's Ore	18	70 19 6
Wheal Emma	39	70 4 0
Camborne Vean	22	57 4 0
Tywarnhaile	19	55 4 0
Druid	24	49 16 0
Nangles	20	48 10 0
South Crinnis	20	40 0 0
Huthnance's Ore	9	23 8 0
Pendarves United	6	18 18 0
South Dolcoath	4	16 2 0
Old Pembroke	2	5 1 0

COMPANIES BY WHOM THE ORES WERE PURCHASED.

Vivian and Sons	4068	£15,015 16 7
Freeman and Co.	1847	7,728 17 7
P. Grenfell and Sons	2796	15,945 15 0
Sims, Willyams, and Co.	2628	12,874 7 4
Williams, Foster, and Co.	4853	19,107 12 5
Mason and Elkington	2388	7,647 14 1
Bankart and Sons	1298	2,523 14 6
Copper Miners' Co.	3461	10,970 9 7
Charles Lambert	2544	10,895 12 6
Newton, Keates, and Co.	422	1,831 13 0
Sweetland, Tuttle, and Co.	2109	5,922 10 11
Total	£28,414	£113,064 3 6

SALES OF COPPER ORES.

COPPER ORES SOLD AT THE SWANSEA TICKETINGS FOR THE QUARTER ENDING SEPTEMBER 30, 1868.

Mines.	BRITISH. Tons.	Amount.
Knockmahon	2675	£15,782 8 0
Berehaven	1149	7,604 6 6
Dyliffe	109	532 2 0
Ballycummisk	53	290 17 6
Total	3986	£24,209 14 0
COLONIAL.		
Moonta	2120	£18,652 5 6
Union (Tilt Cove)	1225	9,423 5 6
Wallaroo	833	4,570 19 6
Paramatta	182	2,136 4 0
Gwalia	56	995 8 0
New Cornwall	74	603 2 0
Total	4490	£36,381 4 6
FOREIGN.		
Bolivian ore and regulus	654	£12,866 1 6
Cuba	812	10,747 8 0
Argentine regulus	53	1,321 5 0
Var	16	456 16 0
Spanish	9	228 0 0
Casali	19	189 10 6
Turkish	39	186 2 0
African	3	94 11 6
Pomona	3	92 14 0
Victor Emanuel	8	80 8 0
Concordia	5	32 11 6
Total	1621	£26,295 8 0
RECAPITULATION.		
British	3986	£24,209 14 0
Colonial	4490	36,381 4 6
Foreign	1621	26,295 8 0
Sundries	466	13,990 1 0
Total	10,572	£100,875 7 6

COMPANIES BY WHOM THE ORES WERE PURCHASED.

Copper Miners Company	868	£ 6,263 8 6
Freeman and Co.	807	9,186 14 6
P. Grenfell and Sons	1186	11,605 18 0
Sims, Willyams, and Co.	962	12,197 7 0
Vivian and Sons	2151	15,329 17 4
Willyams, Foster, and Co.	1868	20,446 2 0
British and Foreign Copper Company	7	302 11 6
Mason and Elkington	412	7,828 17 6
Bankart and Sons	688	5,963 14 0
Charles Lambert	1195	8,792 9 4
Sweetland, Tuttle, and Co.	416	2,573 15 10
Landore Copper Company	12	384 12 0
Total	10,572	£100,875 7 6

THE FRENCH LANGUAGE.—The continually increasing intercourse and good feeling between the English and French nations renders it highly desirable that the people of each country should understand the language of the other, and with a view to facilitate the attainment of this important object Count De. G. LIANCOURT has undertaken the issue of an "Anglo-French Penny Library" (London: Central Depôt, 16A, Tokenhouse-yard), by the use of which a very sound knowledge of the French language may be very speedily acquired. The books are really marvels of cheapness, being beautifully printed upon very good paper and containing a large amount of useful matter. The volumes already issued comprise a French Grammer (64 pages), for one penny; several complete Dramas for the School-room, elementary and advanced; and also a neat little volume of historiettes, forming a valuable exercise book, at the same price. The dramas are each printed with the French and English on opposite pages, which will permit of their being performed with spirit and accuracy. The series deserves extensive circulation.

MANUFACTURE OF STEEL.

In connection with industrial pursuits considerable interest at all times attaches to the observation of the marvellous effect produced by a single discovery, more especially when that discovery permits of the extensive production of an article capable of general application at a reduced price. The inventions which facilitate the manufacture of cheap steel belong to this class, and hence it is that any work comprising an account of these inventions is sure to be received with favour. Not many years ago we were almost inclined to place steel amongst luxuries, its high price having confined its use to the better class of tools, whilst in all cases where large masses of metal were required, and even for the common kinds of tools, iron was exclusively employed. But steel is now of every day use, and an admirable account of the progress of invention which has enabled this change to be brought about is given in the valuable little volume just translated from the French by Mr. Fesquet,* in which he remarks that the enormous progress made recently in iron metallurgy and metallic constructions has prompted the employment in large quantities of new kinds of steel, endowed with properties of resistance and flexibility hitherto unknown and unsuspected, and at a cheapness of cost which has allowed their use for rails, large pieces of machinery, railroad tyres, boiler-plates, ships, bridges, &c. These improvements he very properly attributes to the energy of certain inventors, and to their complete knowledge of the nature and composition of the metal they were working. The scientific principles by which their efforts were directed were the same, the methods to arrive at the result were different.

With regard to the distinction of irons and steel, Mr. Fesquet defines *iron* as the fibrous or granular metal known under that name, combined with a trace of carbon (all commercial irons contain carbon), and which cannot be hardened by the hardening process; *steel*, as the combination of iron with an average of 1 per cent. of carbon, and which can be hardened and melted; and *pig-iron*, as the combination of iron with 3 to 5 per cent. of carbon, which can be melted, and possesses scarcely any malleability. A very small change in the proportion of carbon will affect the properties of steel, yet Mr. Landrin takes cast-steel as a type, because of all known steels its properties and composition are the most constant. Beginning with a history of steel, the author next examines the various fuels employed in metallurgy, the substances which in the ore and the fuel are capable of influencing the qualities of iron and steel, the different ores in use, and then passes on to the theory of the formation of steel, with citations from Réaumur's work, which, although published in 1722, may still be read with advantage, as pointing to the futility of certain secrets and mixtures by which many persons are even now deceived.

The theory of the formation of steel is followed by a method of quantitative analysis for iron, steel, or pig metal; by the metallurgy of natural, puddled, and Wootz steel (special attention being given to the manufacture of pots for casting); and by accounts of the Chenot, Bessemer, Uchatius, and other processes which from time to time have attracted so much attention. Judging from the examination of certain mixtures of steel with other metals, an explanation is given of the various operations by which steel is welded, hardened, and tempered; and, finally, some of the uses to which steel is applied, such as the manufacture of files, wire, plates, needles, and saws, are described. The book, as is usual with all such works by French authors, contains an epitome of all the published information bearing on the subject, from the time of Tubal Cain to the date of publication; the iron bedstead possessed by Og, king of Bashan, being mentioned as evidence of the degree of perfection the art of forging had arrived at even in those early times; and we have then a quotation from Chu-King, cap. Yu Kong, to show that at the time of the Jews' bondage in Egypt steel and iron were already known to the Chinese, whose first chiefs had found mines in the territory of Leang-tcheou. The extent to which the Greeks, the Romans, and other nations of antiquity were acquainted with the use and metallurgy of steel and iron is referred to in an equally interesting manner.

The ancient metallurgists are considered to have worked two kinds of iron ore—a pure ore, which required no preliminary treatment, and an impure ore, which was broken, assorted, washed, and roasted. The pure ore was smelted in low furnaces, similar to a Catalan forge, and produced iron or steel almost by chance, when that ore was rich and without veinstone. The impure or refractory ore, after it had been ascertained that it could not be worked in the same manner, was smelted in much higher furnaces. This was the origin of the high bloomery furnaces. Agricola, A.D. 1546, fails to mention raw metal, or blast furnace, so that it would appear that the art of casting raw metal into moulds is an invention relatively modern, which was unknown in Upper Germany: all indications point to that invention having taken place near the Rhine. In 1409 there was in the valley of Massevaux, between Riembach and Oberbruck, a blast-furnace for smelting iron, which lasted only 30 years: this is the first record of a blast-furnace. The way that Wootz steel is made in Asia brings to mind that the modern metallurgists, when they invented the blast-furnace, have but imitated the processes of Persia, Salem, and Golconda. There cannot be more analogy than there is between these two methods, used in times and countries so far apart; one of these methods being older than the invasion of Alexander the Great, the other born scarcely four centuries since. The oldest fact known in England in relation to the moulding of raw iron is in 1547, when Pierre Baud, a Frenchman, was smelting cast-iron pieces for the English navy: his workman and successor, Thomas Johnson, became celebrated for his skill, and the perfection of his works.

As for the manufacture of steel, the eastern countries were far in advance of Europe, when the Greeks founded forges in the Peninsula, which afterwards were succeeded by the Catelan furnaces in the Pyrenees. In all these works steel was extracted directly from the ore. Biscay for a long time enjoyed great credit for its steel, and Bilboa had still in 1548 the privilege of supplying the English market with fine tools. The great market for these products had early awakened the cupidity of English manufacturers, who tried to counterfeit them. Bad faith went so far that, under the name of Bilboa iron, tools made of hardened iron, without any value or quality, were sold. In 1548 Parliament was obliged to intervene, and to prohibit this reprehensible fraud. In the boundaries of Germany, and since the discovery of raw metal, people thought of refining pig metal, leaving in it enough carbon to made a kind of natural steel. The centre of this manufacture seems to be confined to the Alps. Germany is also the first country where it was proposed to cement iron. Thence the art went to France, and was introduced into Newcastle-on-Tyne long before it was known at Sheffield, the present centre of that manufacture.

Puddling steel is an entirely recent invention: in England this discovery is, according to Mr. Landrin, claimed by Mr. Ewald Riepe, who took a patent in 1850; but it should be stated that Mr. Riepe is a Prussian, and that his invention was first tested in Westphalia. The first experiments Mr. Landrin states to have been made in 1835 at Frantschach, in Carinthia. Messrs. Schlegel and Müller took a patent in 1836, thence the process went to Cibiswald in 1849, and to Neuberg, Styria, in 1851. But the steel obtained did not fulfil all the expectations, and its manufacture was discontinued, either by want of a market or by discouragement. In France steel works have much progressed. In 1833 there were but 69 steel forges, producing 2850 tons of forged steel; in 1852 the production went up to 3938 tons. In 1852 there were produced from 25 cementation, or converting, furnaces 2964 tons of cemented steel; in 1852 that quantity was increased to 9808 tons. The manufacture of cast-steel, which in 54 works was not over 324 tons in 1833, was 4352 tons in 1852.

In dealing with raw materials, heat, oxygen, sulphur, phosphorus, water, lime, iron ores, and fuel are each considered separately, and in a manner that well prepares the reader for the study of the other portions of the book. Referring to steel and its theory, there is one extract from Réaumur's work on steel which is alone worth the entire price of the book. Réaumur died in 1757, yet he fully explained the case-hardening process, and asks—

"Why does iron become able to be so hardened by such an operation? In seeking for the cause I have ascertained that the first layers of metal are converted into steel. . . . . By experiments, which it is useless to mention here, I have been convinced that this portion of iron is converted into steel, and of this workmen really no not take notice; they really use steel tools, and believe them to be iron. The inferences I have drawn from this observation are that the substances employed for case-hardening could be made use of as a basis of proper mixtures for converting iron into steel; that if those who case-harden submitted their pieces to a more protracted fire they would become steel to the centre. . . . . The bases of the composition used for the case-hardening are powdered charcoal, ashes, soot seasoned with salts, and mixed with various substances of a vegetable, animal, or mineral nature. The secrets taught for converting iron into steel are founded generally upon these compositions; but each workman has his favourite ingredients, his particular doses, of which he makes a mystery."

Interesting extracts of this kind might be multiplied to almost any extent from Mr. Landrin's work, but the above will suffice to give a general notion of its character. With regard to the edition now under consideration, it is translated in a manner which certainly reflects the highest credit upon Mr. Fesquet, and the annotations add materially to its value. By way of appendix, excellent accounts of the Bessemer and the Martin processes of manufacturing steel are given from the report of Mr. Hewitt, the United States Commissioner to the Paris Exposition; so that the work, as a whole, is well entitled to be regarded as a text book on the subject of which it treats, and as such should be studied by all interested in the theory, metallurgy, properties, practical working, and use of steel.

* "A Treatise on Steel." By H. C. LANDRIN, Jun., C.E. Translated from the French, with notes, by A. A. FESQUET. Philadelphia: Baird. London: Trubner and Co., Paternoster-row.

The Legislature having decreed that all dealings in shares shall be in future *bona fide*, and contract notes become illegal, unless the specific numbers of the shares sold be inserted therein, speculative transations are wholly suppressed. The wisdom of this measure is open to question—still the result is the same. Dealings must become restricted, and the value of banking business and banking shares find their true level, and in our opinion there is no description of property likely over the space of the ensuing five years so gradually to depreciate in commercial value as "joint-stock banks." They are, unquestionably, trading concerns, and are open to grave and frequent risks, whilst foreign to all other branches of commercial undertakings, they can never command exceptional or feverish values. Speculation can never effect an upward tendency, whilst legitimate demand can alone sustain shares brought to market.

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